

Water Resources Modeling for the California Water Plan

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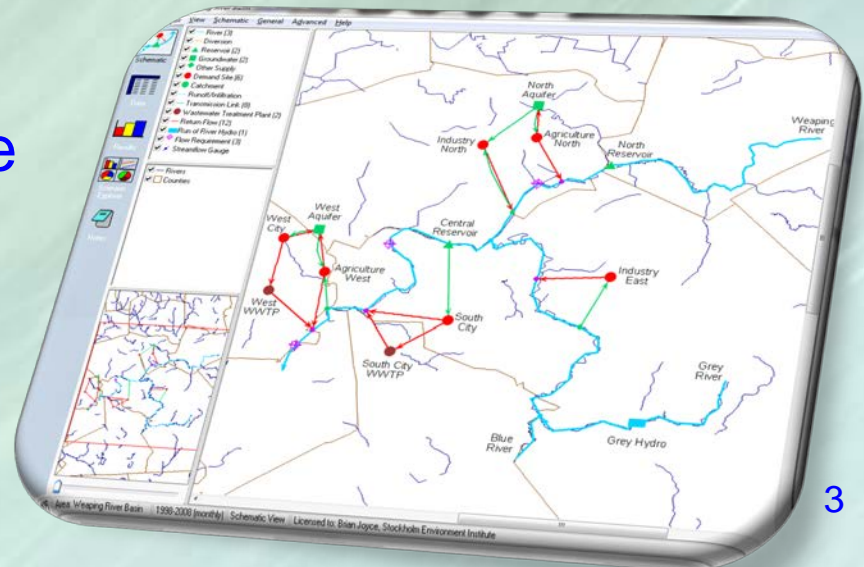
Water Resources Modeling

- 💧 Generic software platform
- 💧 Two applications:
 - Statewide Hydrologic Region (HR) Demand Model
 - Central Valley Planning Area (PA) Model



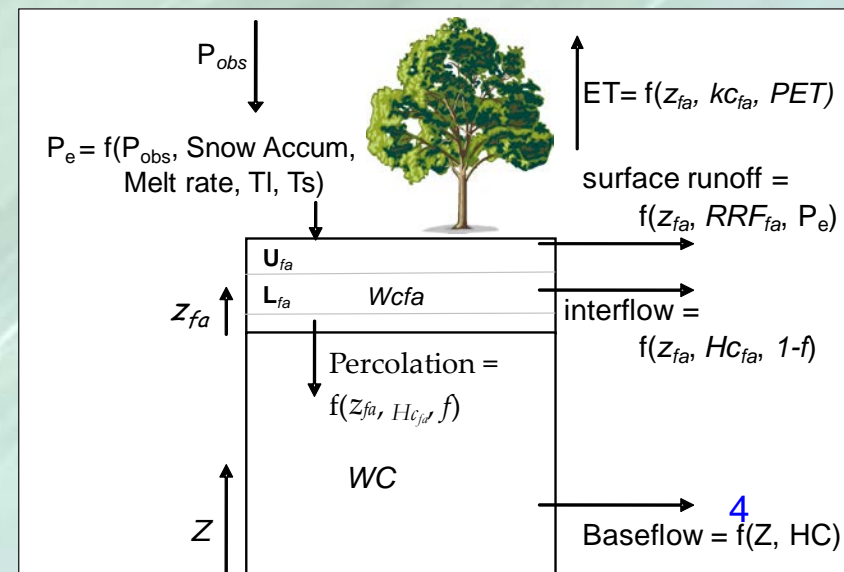
Water Evaluation and Planning System

- 💧 Object-oriented, menu-driven, water resources modeling platform
- 💧 Developed and maintained by the Stockholm Environment Institute (SEI)
- 💧 Integrates watershed hydrology and river basin operations
- 💧 Ideally suited for screening analysis and climate change studies



Water Evaluation and Planning System

- 💧 Study area configured as a set of contiguous catchments
- 💧 Catchments linked by river system
- 💧 Water demands are nested within the catchments
- 💧 Lumped parameter hydrology modules include
 - Snow-melt
 - Rainfall-runoff
 - Evapotranspiration
 - Soil moisture accounting
 - Groundwater



Water Evaluation and Planning System

- ◆ Reservoir releases and water allocation decision driven by linear programming solver
 - Maximize satisfaction of demand
 - User defined demand priorities
 - User defined supply preferences



WEAP Application 1: Statewide HR Demand Model

💧 Model developer

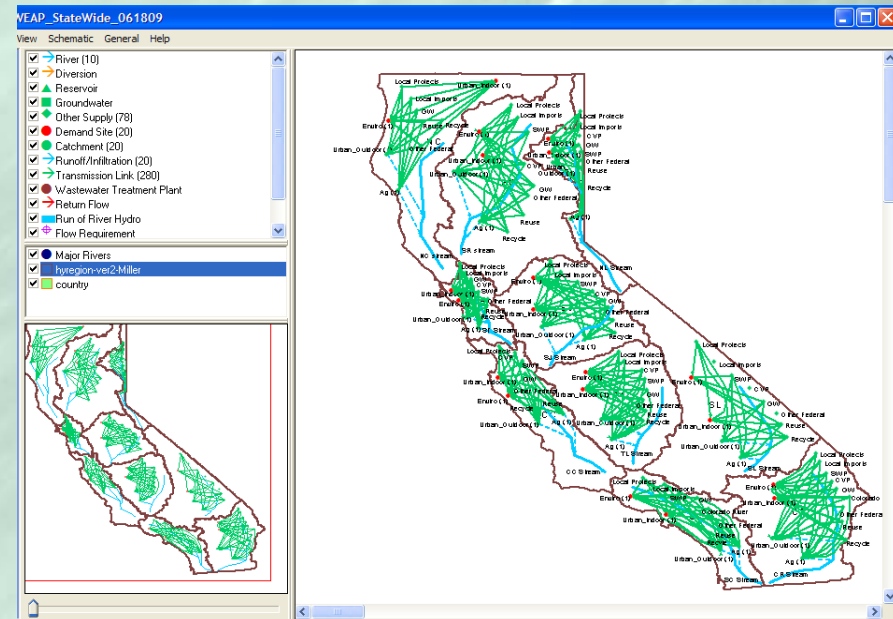
- Mohammad Rayej (DWR)

💧 Hydrologic Region scale

1. North Coast
2. San Francisco Bay
3. Central Coast
4. South Coast
5. Sacramento River
6. San Joaquin River
7. Tulare Lake
8. North Lahontan
9. South Lahontan
10. Colorado River

💧 No representation of supply

Update 2013
California Water Plan Regions not linked



Statewide HR Demand Model

💧 Demands

- Agriculture
 - 20 crop classes
- Indoor M&I, Outdoor M&I
 - Single Family, Multi-Family, Commercial, Industrial, Large landscape
- Environmental



Statewide HR Demand Model

💧 Simulation

- Base year: 2006
- Projection year: 2050
- Time scale: monthly time step

💧 Scenarios

- 9 growth (population/and use) scenarios
- 12 CAT climate change scenarios + 1 repeat of historical climate



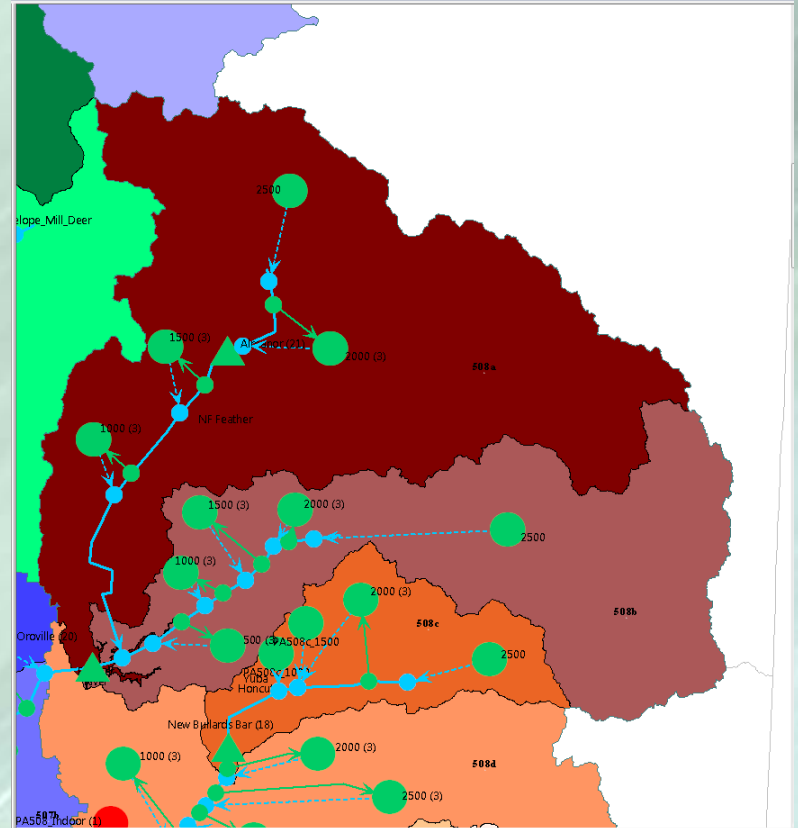
WEAP Application 2: Central Valley PA Model

- 💧 Model developers:
 - David Yates, NCAR
 - Brian Joyce, SEI
 - Evan Bloom, David Groves, RAND
 - Shankar Parvathinathan, MWH
- 💧 Planning Area scale
- 💧 Interconnected model that includes both supply and demand



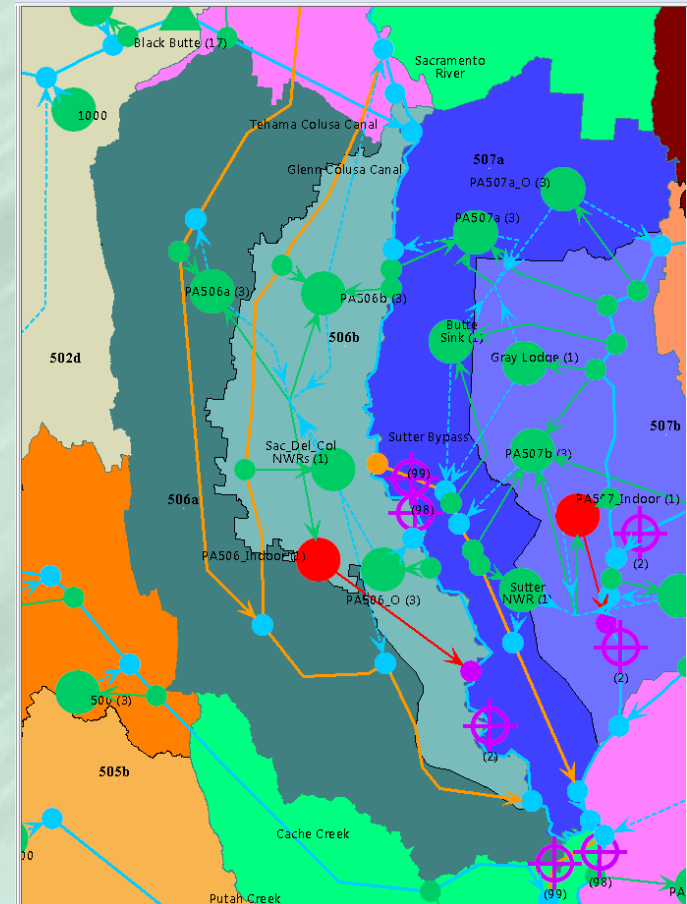
Upper Watersheds

- 25 rim watersheds delineated based on:
 - Planning area
 - Watershed boundaries
 - Surface water storage
- Watersheds further disaggregated by 500m elevation bands



Valley Floor

- 💧 21 “watersheds” delineated based on:
 - Planning area
 - Water sources
- 💧 15 groundwater basins based on Bulletin-118 boundaries
- 💧 Demands
 - Irrigation associated with watershed
 - Addition indoor urban demand sites
 - Flow requirements/targets



System Operations

💧 Reservoirs

- No CVP/SWP contracts and contract allocations
- Operated to meet demand priorities and supply preferences

💧 Delta

- X2
- Salinity (G-Model)
- Minimum required Delta outflow
- VAMP Export Limits
- Export/Inflow Limits (WRD 1641)
- No Coordinated Operations Agreement (COA)
- No Delta Cross Channel
- Old and Middle River reverse flow requirements



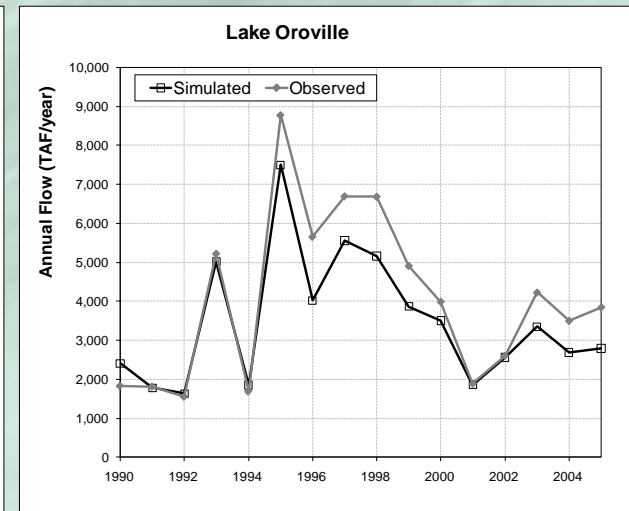
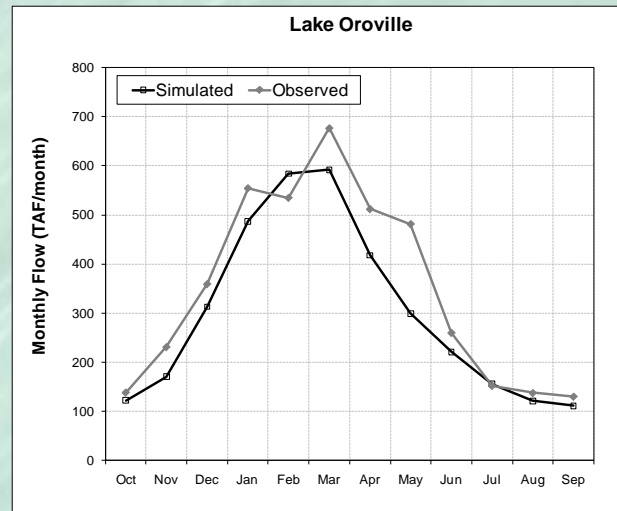
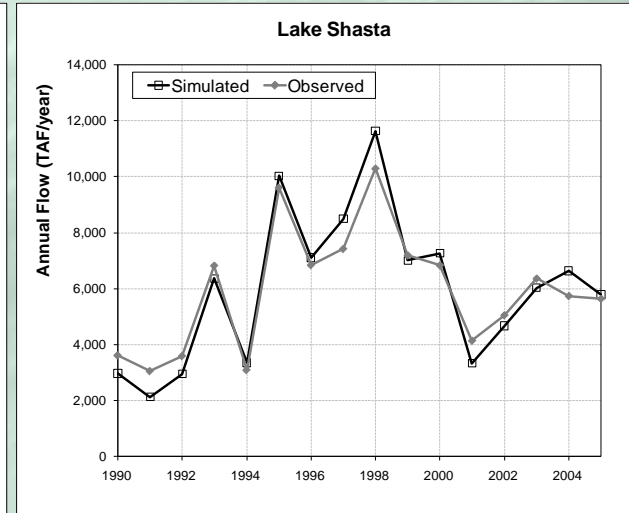
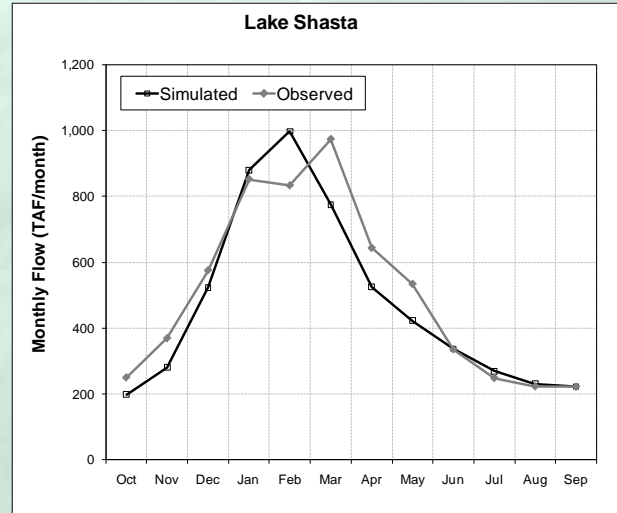
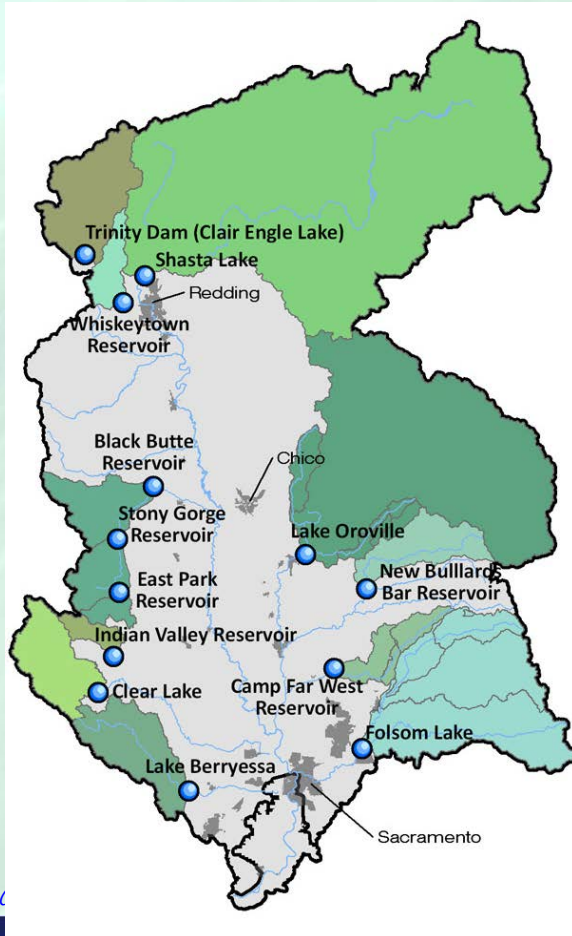
Model Calibration

- 💧 Inflows to major reservoirs: *1970-2005 observed data*
- 💧 Agricultural, urban, wetland water use: *1998-2005 water portfolios*
- 💧 Reservoir storage: *1990-2005 observed data*
- 💧 Groundwater use: *1998-2005 water portfolios*
- 💧 Groundwater elevations: *1970-2005 observed data*
- 💧 Delta inflows and exports: *1990-2005 observed*
- 💧 Delta outflows: *1990-2005 DAYFLOW*



Model Calibration: Reservoir Inflows

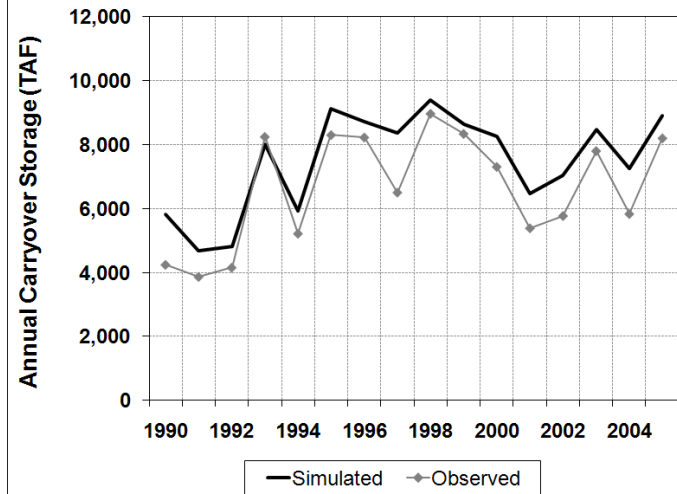
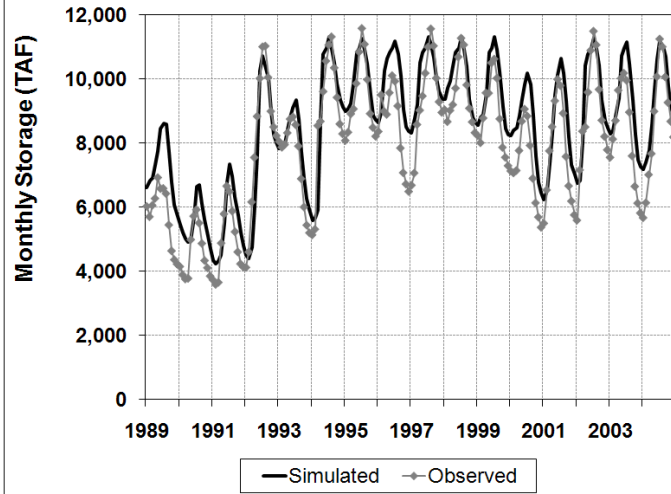
Sacramento River HR



Model Calibration – Surface Storage

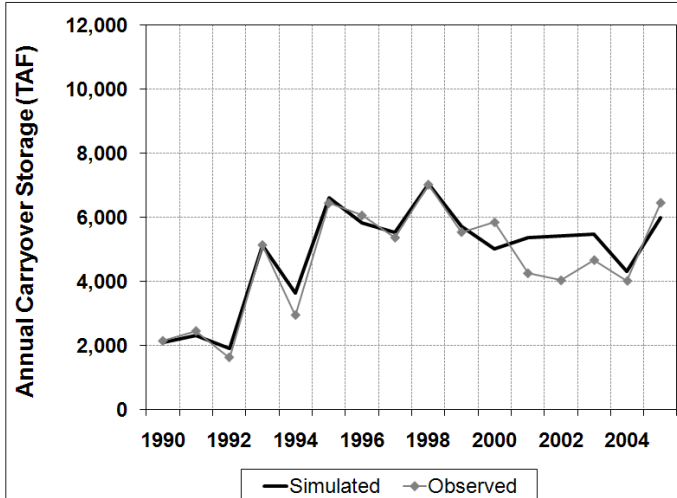
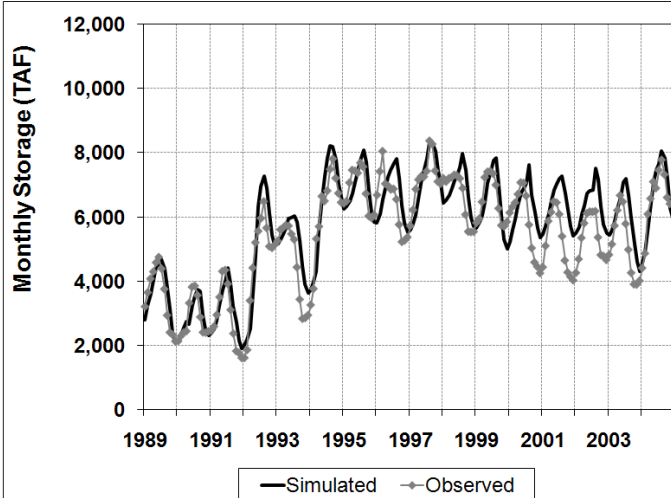
North of Delta

Sum of Trinity, Shasta, Oroville, and Folsom



South of Delta

Sum of New Melones, New Don Pedro, McClure, and Millerton

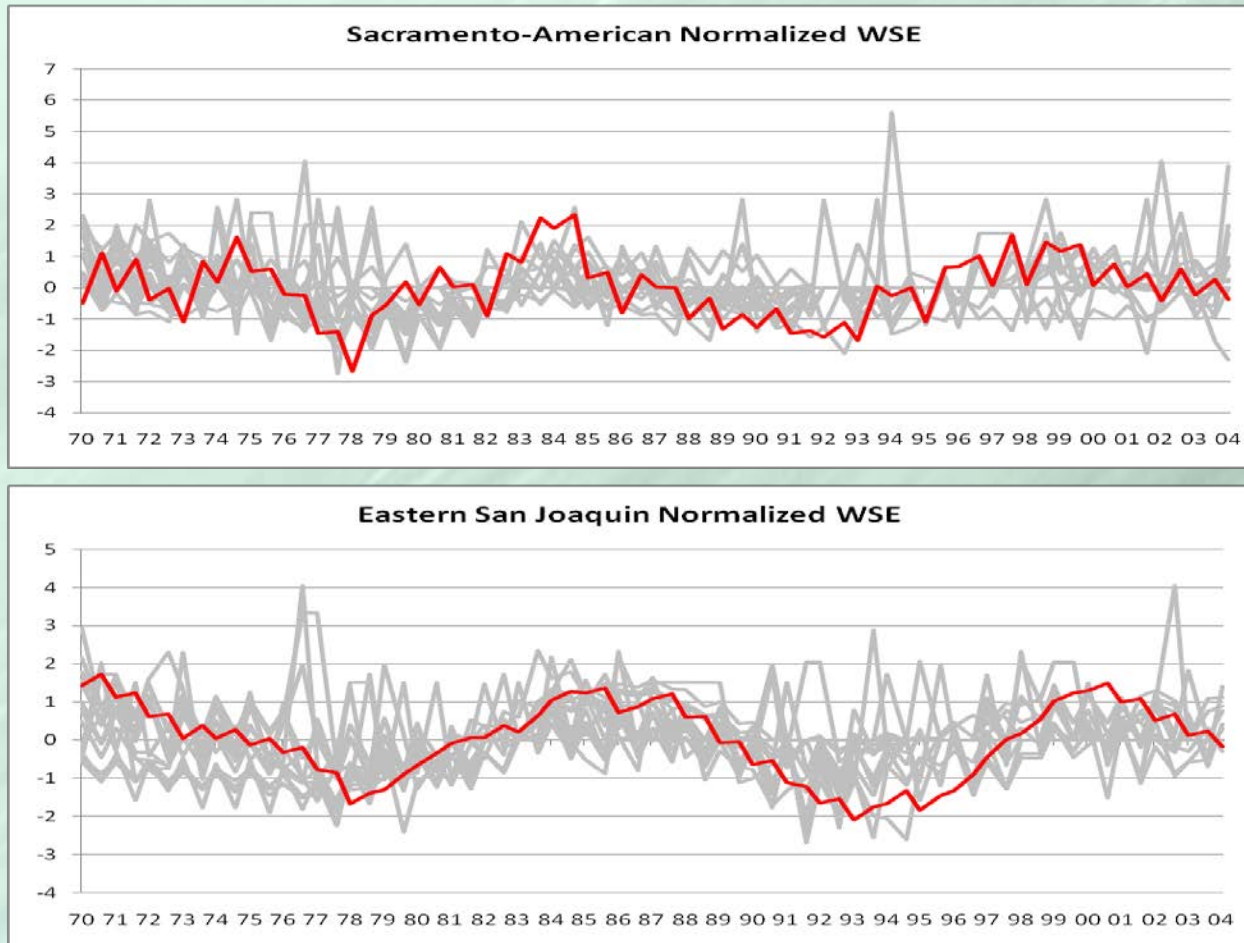


Update 2013

California Water Plan

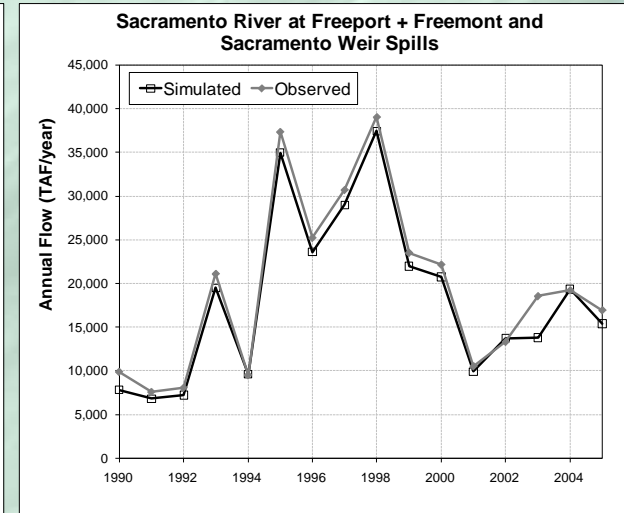
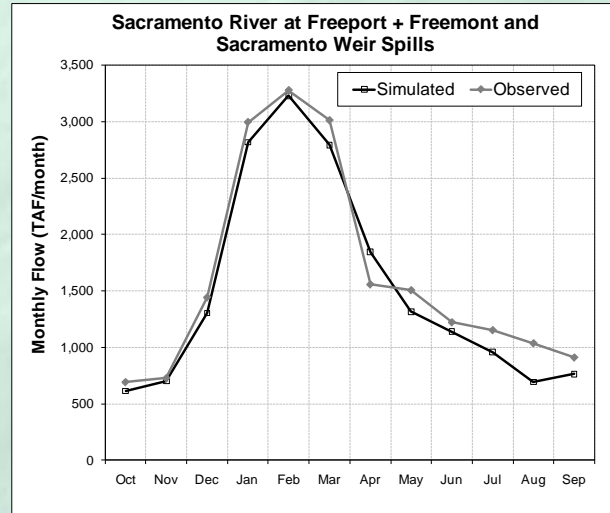


Model Calibration - Groundwater

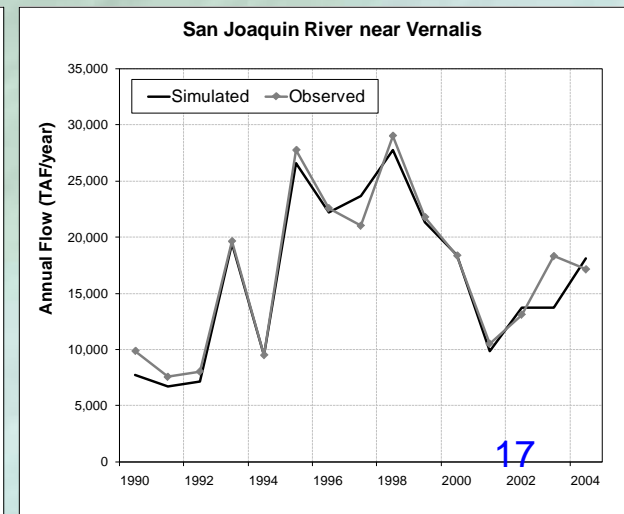
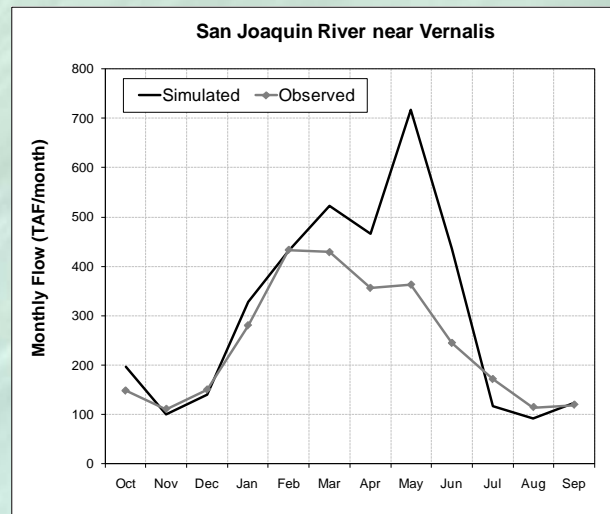


Model Calibration: Stream Flows

Sacramento River at Freeport + Fremont and Sacramento Weir Spills



San Joaquin River near Vernalis



References

💧 WEAP

- <http://www.weap21.org/>
- Yates, D., J. Sieber, D.R. Purkey, and A. Huber-Lee. 2005. “WEAP21, a Demand-, Priority-, and Preference-Driven Water Planning Model: Part 1 Model Characteristics.” *Water International*, 20, 487–500.

💧 Central Valley PA model

- Yates, D., D. Purkey, J. Sieber, A. Huber-Lee, H. Galbraith, J. West, S. Herrod-Julius, C. Young, B. Joyce, and M. Rayej. 2009. “Climate Driven Water Resources Model of the Sacramento Basin, California.” *Journal of Water Resources Planning and Management*, 135(5), 303–313.
- Integrated Scenario Analysis (February 2010). <http://www.waterplan.water.ca.gov/swan/index.cfm>

